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ABSTRACT

This study investigated the effects of distractors on children's task-relevant (central) and task-irrelevant (incidental) recall on a short term visual memory task involving pictures of familiar animals and household articles. The effect of mode of distractor (auditory or visual) and the effect of developmental level were also studied. Subjects were 60 eight-year-old and 60 eleven-year-old male and female children. Recall of central information was expected to decline more for older than younger children in the distraction conditions. This result was confirmed. Interference in recall was expected to be greater with a same-mode distractor (visual) than with a cross-mode distractor (auditory). However, results indicated that incidental recall was greater with the same-mode distractor. Central recall interference varied with the age of the subject, serial position of the correct response, and block of trials studied. Performance on the incidental learning task was expected to be higher with distraction in general as compared to a control condition. This hypothesis was confirmed. Results were discussed in terms of the selective and effective use of encoding strategies and attention deployment in memory tasks. (BD)

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Mode of Interference, Set and Selective Attention[1]

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Previous research on the development of selective encoding of task-relevant (central) versus task-irrelevant (incidental) information has found that central performance improves regularly with increasing age level from preschool to the teen-age years, while incidental learning improves slightly in the early school years and then remains constant or declines by 11-12 years (for a review of studies, see Hagen and Hale, 1973). A model to account for these findings postulates "a developmental improvement in efficiency of attention deployment (p. 136)," and suggests that strategies, which focus on relevant information at the expense of irrelevant or extraneous information, emerge as one identifiable way this efficiency is expressed. It has been argued elsewhere (Hagen and Stanovich, in press) that the developmental improvement in selective encoding of central information does not occur because of the young child's failure to discriminate components of the stimuli. Rather, selectivity as measured by the central-incidental task seems to occur at a stage following initial perceptual discrimination.

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Distractors have been found to have different effects on the central as compared to the incidental measures at various chronological age levels (Hagen and Hale, 1973). The degree to which the distractor interferes with the encoding strategy employed should be related to its effect on the dependent measure. In two studies using an auditory distracting task (Sabo and Hagen, 1973; Hagen and Kail, 1973), central recall was found to be inhibited by distraction in

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children 10-12 years of age but was not affected in children 7-8 years of age. The present study was designed to investigate systematically the effects of distractors on central and incidental performance. Further, whether the mode of distractors differentially affects performance was studied by the inclusion of visual as well as auditory distracting conditions. Finally, developmental changes in the ability to adjust to cognitive "sets" was examined.

Children at two age levels (CA's 8 and 11 years) were tested on a visual short-term memory task for incidental as well as central recall and with distractors which required either auditory or visual attention. Recall of older children on the central task was expected to be impaired more than younger children's recall in the distraction conditions, since the older children are presumably using strategies that are vulnerable to distractors. The distractor of the same mode of presentation as the main task (i,e., visual) was expected to interfere more with the use of strategies than the cross-mode distractor (i.e., auditory). Performance on the incidental learning task was expected to be higher with distraction as compared to a control condition since incidental performance presumably results from inefficiency in the use of encoding strategies.

The other variable involved the "set" conveyed to the children concerning their selection of task-appropriate strategies. In the standard instructions for the central-incidental task, the initial set is to attend to and try to recall locations of central items only and the incidental test then follows as a surprise. In addition to these instructions, a condition was included for which an appropriate strategy was to encode <u>both</u> central and incidental information. It was expected that children at the older age level would adopt this set more readily than the younger children and hence performance on both measures would be affected more by this manipulation at the older age level.

METHOD

Sixty younger children (Mean CA = 8.3 years) and 60 older children (Mean CA = 11.4 years) participated in the study. The children were from white, middle-class homes. Approximately half were males and half were females. At each age level, twenty children were randomly assigned to one of the three conditions: control-no delay, visual distraction, and auditory distraction.

The central task was the serial position recall task (Hagen, 1967). On each trial, seven cards, each depicting a familiar animal and a household object (cat-lamp, dog-table, etc.) were successively presented for approximately 2 seconds. After this brief exposure, each card was turned over and placed in front of the subject, from his left to his right. At the end of each trial, a cue card depicting one of the household objects was shown, and the task was to find the card with that object in the series. As feedback, the experimenter turned over the correct matching card. After seven trials were presented, all serial positions and cards had been probed. Central recall scores consisted of the number of pictures located correctly. Responses were also scored by serial positions.

After the block of seven trials, incidental performance was assessed. The child was shown each of the cue cards depicting a household object, and was asked to indicate which animal had always appeared with it on the cards. Then the entire procedure was repeated. Subjects were now implicitly "set" for both central and the incidental information.

In the two distraction conditions, the procedure was the same as just described except that, on each trial, a 15-second distracting task occurred between the presentation of the stimulus cards and the probe for central recall. In the visual distraction condition, five pairs of circles of various sizes were shown, and the child

was asked to indicate for each pair whether or not the circles were identical in size. In the auditory distraction condition, the child listened to a tape-recording of five pairs of piano notes and for each pair judged the similarity in tone of the two notes. Testing took place in a room within the school, and took approximately twenty minutes. Two male and two female experimenters administered the tasks.

RESULTS AND DISCUSSION

The analysis for central recall scores was performed on both the original scores of proportion correct responses and on adjusted scores to correct for a possible response bias, such as guessing certain positions more frequently than others. The index used was the a posteriori probability of a correct response, that is computed by dividing the number correct at each serial position by the number of times that position was chosen (Berch, 1975). The results were similar to raw scores; therefore only analyses with adjusted scores are reported. For the main anlyses, the scores for central recall for each of the two trial blocks were combined into mean scores at each serial position.

To examine overall differences among the groups, a three-way analysis of variance for age level, conditions and serial position (repeated measure) was performed. There were significant age ($p < .02$) and serial position ($P < .0001$) effects, but neither condition nor interaction effects were significant. Thus, older children demonstrated overall higher recall than younger children. In the no-distraction condition only, older children showed a primacy effect, replicating earlier findings (e.g., Hagen & Kingsley, 1968; Hagen, Meacham & Mesibov, 1970; and Hagen & Kail, 1973). These findings are interpreted to mean that older, but not younger children use a strategy of cumulative rehearsal that enhances primacy recall.

Recall of recency items, presumably in shorter-term store and thus not as dependent on strategies, was evident at both age levels.

Age comparisons at the primacy positions of the serial recall data revealed that older children performed better than younger children at the first serial position, in the no-distraction condition only ($p < .001$). In the two distraction conditions, older children's primacy performance did not differ significantly from the performance of the younger children. Thus, the older children lost whatever advantage they had over the younger at the primacy position in central recall, so it appears that the distractors interfered with the use of a rehearsal strategy.

Even though overall recall did not vary by condition, the effects of distractors on primacy recall were examined by one-way analyses of variance for conditions and by age level at the first two serial positions. A significant condition effect ($p < .05$) was found for the younger children. Contrasts indicated that younger subjects' recall at the primacy positions was significantly better under visual distraction, than in either the auditory distraction ($p. < .03$) or the no-distraction ($p < .02$) conditions. It appears that the introduction of a visual distractor actually enhanced younger children's primacy recall, while there was a slight reduction in older subjects' performance in this condition.

A comparison of overall performance on the two blocks of trials for the three conditions at the two age levels was made. As expected, recall of central information declined on the second block of trials at both age levels. The only exception was for younger children's performance in the control condition. The implications of these findings are discussed below.

Recall of the incidental information was analyzed next. An analysis of variance for age level, conditions and trial blocks (repeated measure) revealed no significant age differences, but significant effects for condition ($p < .01$), trial block ($p < .01$)

and age x trial block interaction ($p < .01$).

The effects of cognitive set were examined. Since children did not anticipate the incidental recall task during the first trial block, but could anticipate it during the second, it was expected that incidental recall would improve on the second block, and more so for the older than the younger children. Comparisons of the two incidental recall tasks, indeed, revealed that both younger and older children performed significantly better on the second recall task ($p < .01$ for both age groups).

The effects of age and conditions were further examined by analyses of variance for each incidental task. While there were no significant differences between the younger and the older children in the recall of incidental information on the first trial block, older children performed significantly better than younger children on the second trial block of the incidental task ($p < .05$). Thus, even though performance improved significantly on the second trial block for both age levels, older children seemed to take better advantage of the set that "incidental" information would be needed later than did the younger children. By age 11 years, children seem to adjust their task strategies more efficiently to changes in the task requirements than the younger children.

Comparisons of performance in the distraction and control conditions at the two age levels revealed significant condition effects for both blocks of incidental scores ($p < .05$, $p < .01$). On the first incidental recall measure, more information was recalled in the visual distraction condition than in either the control ($p < .01$) or the auditory distraction ($p < .06$) conditions. For the second measure, recall was again higher under visual distraction than in the control condition ($p < .01$), and slightly higher than with the auditory distractor ($p < .11$). The higher incidental performance under visual distraction, as compared to the two other conditions, suggests that the within-mode distractor caused more interference than the cross-mode distractor.

The increase of incidental performance produced by the distractors shows that distractors do not necessarily cause a reduction in the encoding and storing of information. Rather, it appears that distraction interferes primarily with the encoding strategies that facilitate recall of the central information in older children. Hence, distractors have differential effects on the recall of central as compared to incidental information. On the central task, with distraction, recall of older children declined and did not differ from that of younger children. Incidental performance, on the other hand, was consistently higher under distraction with one exception.

The increased incidental performance found here when distractors were imposed fits nicely with our developmental model of selective attention (Hagen & Hale, 1973). A basic proposition of the model is that incidental performance is indicative of inefficiency in the encoding and storage of information in the central-incidental task. Encoding strategies are vulnerable to distractions, yet the motivation to perform well on the task remains high. Thus, a greater amount of incidental information gets encoded and is available for retrieval under these conditions. Children at both age levels are susceptible to the disrupting effects of distractions.

The decline in central recall found at both age levels for the second block of trials as compared to the first also fits the prediction derived from the model. That is, the "set" to encode incidental items for later recall of the second trial block would shift attention from the central information at least to some extent. For incidental performance, older children's recall increased more than did younger children's from trial block 1 to trial block 2. It should be clear, here, that for the second trial block incidental performance cannot be viewed as simply evidence for inefficient processing, since the children have every reason to believe that this information might well be useful shortly. Hence, the greater increase for the older children for the second block indicates that they indeed showed flexibility in

shifting strategies to include encoding of the incidental items in the task.

The case for selection of information at a point in processing after initial discrimination, presented at the beginning of this paper, received support from this study. The distractors were introduced between the presentation of stimuli and the testing for recall. Hence, their effectiveness must have operated at the encoding stage rather than at the stage of initial input. Our argument that important developmental changes occur in the selection and effective use of encoding strategies in memory tasks has received substantial support in this study.

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